

**FINAL REPORT
JUNE 2006**

REPORT NO. 06-18



**QUALIFICATION TESTING FOR CLIPLESS SEAL USED ON 3/4" BANDING,
40" x 48" WOOD PALLET WITH .50 CALIBER AMMUNITION IN
M2 METAL BOXES IN WIRE BOUND BOXES IAW MIL-STD-1660,
"DESIGN CRITERIA FOR AMMUNITION UNIT LOADS"**

Prepared for:

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Building 354
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Picatinny Arsenal, NJ 07806-5000



**DEFENSE AMMUNITION CENTER
VALIDATION ENGINEERING DIVISION
MCALESTER, OKLAHOMA 74501-9053**

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**QUALIFICATION TESTING FOR CLIPLESS SEAL
USED ON ¾" BANDING, 40" x 48" WOOD PALLET
WITH .50 CALIBER AMMUNITION IN M2 METAL BOXES
IN WIRE BOUND BOXES, IAW MIL-STD-1660,
"DESIGN CRITERIA FOR AMMUNITION UNIT LOADS"**

ABSTRACT

The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SJMAC-DEV) conducted qualification tests for the Clipless Seal used on ¾"-wide steel banding on a 40" x 48" wood pallet with .50 Caliber ammunition in M2 metal boxes in wire bound boxes IAW MIL-STD-1660, "Design Criteria for Ammunition Unit Loads," assembled by Alliant Techsystems (ATK), from Independence, Missouri.

Two test units were tested with a load of 4,200 lbs. each. The tests accomplished on the test units were the stacking, vibration, drop, incline impact, forklift handling, and disassembly tests. It was noted that on all four sample pallet units received from ATK, from Independence, Missouri, the last puncture on the clipless seal on all the horizontal banding seals did not puncture through the material properly and only dimpled the banding. To ensure the banding is securely sealed, the sealer should be adjusted to punch through the material in the future. Test Unit #1 and #2 were tested in accordance with MIL-STD-1660 at ambient temperature, with no significant problems encountered. The banding did loosen around the boxes, but remained intact on the pallets and still provided a stable and secure pallet.

Unit loads strapped with the Frey & Weische WS 19/3 + 1 Hydraulic head used with automated palletizing equipment to make a clipless seal passed the requirements of MIL-STD-1660. This clipless seal notching can only be used as a replacement for the current seal identified in the material specifications in the 19-48-4116 basic procedural drawing (ref ACV00617) for 3/4"- wide steel banding only. Only boxed ammunition and components on 4-way entry wood

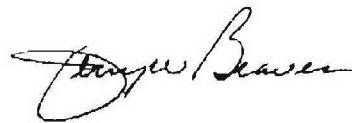
pallets covered by 19-48-4116 series drawings are approved for U. S. Army use with this clipless seal head used in automatic palletizer equipment for 3/4"- wide steel banding.

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VALIDATION ENGINEERING DIVISION
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**QUALIFICATION TESTING FOR CLIPLESS SEAL
USED ON 3/4" BANDING, 40" x 48" WOOD PALLET
WITH .50 CALIBER AMMUNITION IN M2 METAL BOXES
IN WIRE BOUND BOXES, IAW MIL-STD-1660,
"DESIGN CRITERIA FOR AMMUNITION UNIT LOADS"**

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PART 1 – INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SJMPC-DEV) conducted qualification tests for the Clipless Seal Used on ¾" Wide Steel Banding on a 40" x 48" Wood Pallet with .50 Caliber Ammunition in M2 Metal Boxes in Wire Bound Boxes in Accordance with MIL-STD-1660, "Design Criteria for Ammunition Unit Loads", assembled by Alliant Techsystems (ATK), from Independence, Missouri. Two test units were tested with a load of 4,200 lbs each. The tests accomplished on the test units were the stacking, vibration, drop, incline impact, forklift handling, and disassembly tests. It was noted that on all four sample pallet units received from Alliant Techsystems (ATK), from Independence, Missouri, the last puncture on the clipless seal on all the horizontal banding seals did not puncture through the material properly and only dimpled the banding. To ensure the banding is securely sealed the sealer should be adjusted to punch through the material in the future. The unitization procedures were provided by DAC, Transportation Engineering Division (SJMPC-DET).

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Joint Munitions Command (JMC), Rock Island, IL. Reference is made to the following:

1. AR 740-1, 15 June 2001, Storage and Supply Activity Operation
2. OSC-R, 10-23, Mission and Major Functions of U.S. Army Defense Ammunition Center (DAC) 21 Nov 2000.

C. OBJECTIVE. The objective of the tests was to determine if the Clipless Seal could be utilized on the 40" x 48" Wood Pallet with .50 Caliber Ammunition in M2 Metal Boxes in Wire Bound Boxes, met the MIL-STD-1660 test requirements prior to the acceptance of the unitization procedures by the U.S. Army.

D. CONCLUSION. Test Unit #1 and #2 was tested in accordance with Mil-Std-1660 at ambient temperature, with no significant problems encountered. The banding did loosen around the boxes but remained intact on the pallets and still provided for a stable and secure pallet. Unit loads strapped with the Frey & Weische WS 19/3 + 1 Hydraulic head used with automated palletizing equipment to make a clipless seal passed the requirements of MIL-STD-1660. This clipless seal notching can only be used as a replacement for the current seal identified in the material specifications in the 19-48-4116 basic procedural drawing (ref ACV00617) for 3/4"- wide steel banding only. Only boxed ammunition and components on 4-way entry wood pallets covered by 19-48-4116 series drawings are approved for U.S. Army use with this clipless seal head used in automatic palletizer equipment for 3/4" wide steel banding.

PART 2 - ATTENDEES

DATE PERFORMED:

Test Unit #1- May 17-18, 2006

Test Unit #2- May 17-18, 2006

ATTENDEE

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PART 3 - TEST PROCEDURES

MIL-STD-1660 TEST.

The test procedures outlined in this section were extracted from the MIL-STD-1660. The tests are conducted on ammunition pallet units or unit loads and are summarized as follows:

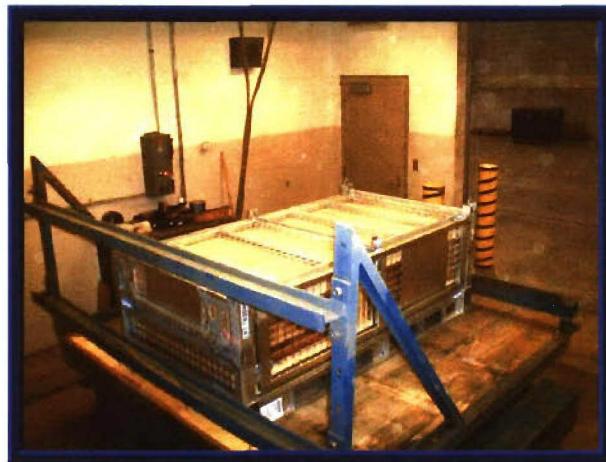
A. STACKING TEST. The test unit will be tested to simulate a stack of identical items stacked 16 feet high, for a period of one hour. This stacking load will be simulated by subjecting the specimen to a compression weight equal to an equivalent 16-foot stacking height. Photo 1 below shows an example of a unit load in the compression tester.



Photo 1. Example of Stacking Test.
(2.75-inch Hydra 70, PA151 Rocket Pallet in the Stacking Test.)

B. REPETITIVE SHOCK TEST. The repetitive shock test is conducted IAW Method 5019, Federal Standard 101. The test procedure is as follows: The test unit will be placed on (not fastened to) the platform. With the test unit in one

position, the platform will be vibrated at $\frac{1}{2}$ -inch amplitude (1-inch double amplitude) starting at a frequency of approximately 3 cycles-per-second. The frequency will be steadily increased until the specimen leaves the platform. The resonant frequency is achieved when a 1/16-inch-thick feeler gage momentarily slides freely between every point on the specimen in contact with the platform at some instance during the cycle. Midway into the testing period, the specimen will be rotated 90 degrees, and the test continued for the duration. Unless failure occurs, the total time of vibration will be three hours. Photo 2 shows an example of the repetitive shock test.



**Photo 2. Example of the Repetitive Shock Test.
(MSTF Low)**

C. EDGEWISE-ROTATIONAL DROP TEST. This test is conducted using the procedures of Method 5008, Federal Standard 101. The procedure for the edgewise-rotational drop test is as follows: The test unit will be placed on its skids with one end of the pallet supported on a beam 6 inches high. The height of the beam will be increased as necessary to ensure that there is no support for the skids between the ends of the specimen when the dropping takes place, but should not be high enough to cause the specimen to slide on the supports when the dropped end is raised for the drop. The unsupported end of the specimen is then raised and allowed to fall freely to the concrete, pavement, or similar

unyielding surface from a prescribed height. Unless otherwise specified, the height of drop for Level A protection will conform to the following tabulation:

GROSS WEIGHT (WITHIN RANGE LIMITS) (Pounds)	DIMENSIONS OF ANY EDGE, HEIGHT OR WIDTH (WITHIN RANGE LIMITS) (Inches)	HEIGHT OF DROPS ON EDGES	
		Level A (Inches)	Level B (Inches)
150-250	60-66	36	27
250-400	66-72	32	24
400-600	72-80	28	21
600-1,000	80-95	24	18
1,000-1,500	95-114	20	16
1,500-2,000	114-144	17	14
2,000-3,000	Above 145- No limited	15	12
Above – 3,000		12	9

Figure 1.



Photo 3. Example of Edgewise-Rotational Drop Test
(MSTF Low)

D. INCLINE-IMPACT TEST. This test is conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the incline-impact test is as follows: The test unit will be placed on the carriage with the surface or edge to be impacted projecting at least 2 inches beyond the front end of the carriage. The carriage will be brought to a predetermined position on the incline and released. If it were desired to concentrate the impact on any particular position on the container, a 4- x 4-inch timber may be attached to the bumper in the desired position before the test. The carriage will not strike any part of the timber. The position of the specimen on the carriage and the sequence in which surfaces and edges are subjected to impacts may be at the option of the testing activity and dependent upon the objective of the test. When the test is to determine satisfactory requirements for a container or pack, and, unless otherwise specified, the specimen will be subjected to one impact on each surface that has each dimension less than 9.5 feet. Unless otherwise specified, the velocity at the time of the impact will be 7 feet-per-second. Photo 4 shows an example of this test.



**Photo 4. Example of the Incline-Impact Test.
(2.75-Inch, Hydra 70, PA151 Rocket Pallet on incline-impact tester.)**

E. SLING COMPATIBILITY TEST. The test unit utilizing special design or non-standard pallets will be lifted, swung, lowered and otherwise handled as necessary, using slings of the types normally used for handling the unit loads under consideration. Slings will be easily attached and removed. Danger of slippage or disengagement when load is suspended will be cause for rejection of the specimen.

F. FORKLIFTING TESTS. The test unit will be lifted clear of the ground by a forklift from the end of the test unit and transported on the forks in the level or back-tilt position. The forklift will pass over the Optional Rough Handling Course For Forklift Trucks as outlined in MIL-STD-1660. The course will consist of parallel pairs of 1-inch boards spaced 54 inches apart and will be laid flat wise on the pavement across the path of the forklift. One pair will be laid at an angle of approximately 60 degrees to the path so that the left wheel strikes first. Another pair will be laid securely across the path of the forklift so that the wheels strike simultaneously. Another pair will be laid at an angle of approximately 75 degrees to the path so that the right wheel strikes first. The test unit will be transported over the Optional Rough Handling Course. The test unit shall be observed for deflection and damage. The test unit will be rotated 90 degrees and the test unit lifted from the side and the above steps repeated.

G. DISASSEMBLY TEST. Following all rough handling tests the test unit may be squared up within 2 inches of its original shape and on a flat level surface. The strapping will then be cut and removed from the palletized load. Assembly of the test unit will be such that it retains its unity upon removal of the strapping.

PART 4 - TEST EQUIPMENT

A. COMPRESSION TESTER.

- | | |
|-----------------------|----------------------|
| 1. Manufacturer: | Ormond Manufacturing |
| 2. Platform: | 60- x 60-inches |
| 3. Compression Limit: | 50,000 pounds |
| 4. Tension Limit: | 50,000 pounds |

B. TRANSPORTATION SIMULATOR.

- | | |
|------------------|---------------------|
| 1. Manufacturer: | Gaynes Laboratory |
| 2. Capacity: | 6,000-pound payload |
| 3. Displacement: | 1/2-inch amplitude |
| 4. Speed: | 50 to 400 RPM |
| 5. Platform: | 5- x 8-foot |

C. INCLINED PLANE.

- | | |
|------------------|--------------------|
| 1. Manufacturer: | Conbur Incline |
| 2. Type: | Impact Tester |
| 3. Grade: | 10 percent incline |
| 4. Length: | 12-foot |

PART 5 - TEST RESULTS

5.1. TEST UNIT DATA. The test unit was inertly loaded to the specified design weight using inert materials. The test unit was prepared using the unitization procedures specified in Part 6 – Drawings. Special care was taken to ensure that each M2 Metal Box had the proper amount of weight in order to achieve a realistic pallet center of gravity (CG). Once properly prepared, Test Units #1 and #2 were tested using MIL-STD-1660 requirements. It was noted that on all four sample pallet units received from Alliant Techsystems (ATK), of Independence, Missouri, the last puncture on the clipless seal on all the horizontal banding seals did not puncture through the material properly and only dimpled the banding. To ensure the banding is securely sealed, the sealer should be adjusted to punch through the material in the future. Photo 5 shows the dimpled banding.

TEST UNIT #1

40" x 48" Wood Pallet with 48 Wire Bound Boxes with 2 each M2 Metal Boxes Loaded with 40lbs each of inert material

Test Date: 17 –18 May 2006 (MIL-STD-1660)

Gross Weight: 4,200 pounds

Length: 51 inches

Width: 43 1/2 inches

Height: 39 inches

Mfgr: Alliant Techsystems, Independence, Missouri

TEST UNIT #2

40" x 48" Wood Pallet with 48 Wire Bound Boxes with 2 each M2 Metal Boxes Loaded with 40lbs each of inert material

Test Date: 17 –18 May 2006 (MIL-STD-1660)

Gross Weight: 4,200 pounds

Length: 51 inches

Width: 43 1/2 inches

Height: 39 inches

Mfgr: Alliant Techsystems, Independence Missouri



Photo 5. Dimpled Seal.

A. MIL-STD-1660 TEST RESULTS TEST UNIT #1:

1. STACKING TEST. The test unit was compressed with a load force of 16,800 pounds for 60 minutes on 17 May 2006. No damage was noted as a result of this test. Photo 6 shows the test unit in the compression unit.



Photo 6. Test Unit in the Stacking Test.

2. REPETITIVE SHOCK TEST. The test unit was vibrated 90 minutes at 210 RPM in the longitudinal orientation and 90 minutes at 198 RPM in the lateral orientation on 17 May 2006. No damage was noted as a result of this test. Photo 7 shows the test unit on the vibration platform.



Photo 7. Test Unit During Repetitive Shock Testing.

3. EDGEWISE-ROTATIONAL DROP TEST. The test unit was edgewise rotationally dropped from a height of 12 inches on both longitudinal sides and both lateral sides. No significant damage was noted as a result of this test, however it was noted the strapping loosened during the drop tests. The pallet was still secure and could continue safely with its intended mission. Photo 8 shows the test unit during the edgewise drop test.



Photo 8. Edgewise Drop Test on the Test Unit.

4. INCLINE-IMPACT TEST. The test unit was impact tested on both longitudinal sides and both lateral sides on the 18th of May. No significant damage was noted as a result of this test. See Photo 9 for the specimen during the lateral incline-impact test.



Photo 9. Incline-Impact Testing of the Test Unit.

5. SLING COMPATIBILITY TEST. N/A.

6. FORKLIFTING TEST. The test unit was lifted clear of the ground by a forklift from both longitudinal sides and both lateral sides and transported on the Optional Rough Handling Course For Forklift Trucks. The test unit was carried over the course three times in the longitudinal and lateral orientations. No damage was noted as a result of this test. Photo 10 shows the test unit passing over the forklift course.



Photo 10. Test Unit Being Carried Over Forklift Course

7. DISASSEMBLY TEST. Inspection revealed no damage.

8. CONCLUSION. No major problems were encountered during the completion of the required testing. The unit load strapped with the Frey & Weische WS 19/3 + 1 Hydraulic head used with automated palletizing equipment to make a clipless seal passed the requirements of MIL-STD-1660.

B. MIL-STD-1660 TEST RESULTS TEST UNIT#2:

1. STACKING TEST. The test unit was compressed with a load force of **16,800** pounds for 60 minutes on 17 May 2006. No damage was noted as a result of this test.

2. REPETITIVE SHOCK TEST. The test unit was vibrated 90 minutes at **212** RPM in the longitudinal orientation and 90 minutes at **195** RPM in the lateral orientation on 18 May 2006. No damage was noted as a result of this test.

3. EDGEWISE-ROTATIONAL DROP TEST. The test unit was edgewise rotationally dropped from a height of 12 inches on both longitudinal sides and both lateral sides. No significant damage was noted as a result of this test. The banding did loosen as it did with the first test Unit.

4. INCLINE-IMPACT TEST. The test unit was impact tested on both longitudinal sides and both lateral sides. No significant damage was noted as a result of this test

5. SLING COMPATIBILITY TEST. N/A.

6. FORKLIFTING TEST. The test unit was lifted clear of the ground by a forklift from both longitudinal sides and both lateral sides and transported on the Optional Rough Handling Course For Forklift Trucks. The test unit was carried over the course three times in the longitudinal and lateral orientations. No damage was noted as a result of this test.

7. DISASSEMBLY TEST. Inspection revealed no damage.

8. CONCLUSION. Unit loads strapped with the Frey & Weische WS 19/3 + 1 Hydraulic head used with automated palletizing equipment to make a clipless seal passed the requirements of MIL-STD-1660. This clipless seal notching can only be used as a replacement for the current seal identified in the material specifications in the 19-48-4116 basic procedure drawing (ref ACV00617) for 3/4" wide steel banding only. Only boxed ammunition and components on 4-way entry wood pallets covered by 19-48-4116 series drawings are approved for U.S. Army use with this clipless seal head used in automatic palletizer equipment for 3/4"-wide steel banding.

PART 6– DRAWINGS

The following test sketches represent the load configuration that was subjected to the test criteria.

APPENDIX 14

UNITIZATION PROCEDURES FOR BOXED AMMUNITION AND COMPO- NENTS ON 4-WAY ENTRY PALLETS

CARTRIDGE, CALIBER .50, PACKED VARIOUS QUANTITIES PER M2 SERIES METAL BOX, 2 M2 SERIES METAL BOXES PER WIREBOUND BOX, UNITIZED 48 BOXES PER 40" X 48" PALLET; APPROX BOX SIZE 14-1/2" L X 12-3/4" W X 8-3/8" H

NOTICE: THIS APPENDIX CANNOT STAND ALONE BUT MUST BE USED IN CONJUNCTION WITH THE BASIC UNITIZATION PROCEDURES DRAWING 19-48-4116-20PA1002.

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ENGINEERING DIRECTORATE <i>J. P. White</i>				19 48 4116/14 20PA1002
U.S. ARMY DEFENSE AMMUNITION CENTER				

REVISIONS

REVISION NO. 8, DATED DECEMBER 1986, CONSISTS OF:

1. ADDING ALTERNATIVE FILLER ASSEMBLY.
2. DELETING ITEMS BY NATIONAL STOCK NUMBER TO "PALLET UNIT DATA" CHART.

REVISION NO. 9, DATED OCTOBER 1987, CONSISTS OF:

1. ADDING ITEM BY NATIONAL STOCK NUMBER TO "PALLET UNIT DATA" CHART.
2. CHANGING BOX DIMENSIONS.
3. UPDATING DRAWING TO CONFORM TO 1 AND 2 ABOVE.

REVISION NO. 10, DATED SEPTEMBER 1989, CONSISTS OF:

1. ADDING ALTERNATIVE STRAPPING.
2. ADDING GENERAL NOTES "J" THRU "M".
3. DELETING ITEMS BY NATIONAL STOCK NUMBER TO "PALLET UNIT DATA" CHART.

REVISION NO. 11, DATED AUGUST 1994, CONSISTS OF:

1. ECP MOS3054 DATED 90-05-24.
2. ADDING ITEM BY NATIONAL STOCK NUMBER TO "PALLET UNIT DATA" CHART.
3. CHANGING WEIGHT AND COMP GROUP OF ITEM IN "PALLET UNIT DATA" CHART.

REVISION NO. 12, DATED DECEMBER 1998, CONSISTS OF:

1. ADDING ITEM BY NATIONAL STOCK NUMBER TO "PALLET UNIT DATA" CHART.
2. DELETING GENERAL NOTE RELATING TO STRAP CUTTER AND RE-LETTERING OTHER GENERAL NOTES.

REVISION NO. 13, DATED OCTOBER 2000, CONSISTS OF:

ADDING ITEMS BY NATIONAL STOCK NUMBER TO "PALLET UNIT DATA" CHART

REVISION NO. 14, DATED NOVEMBER 2002, CONSISTS OF:

ADDING ITEMS BY NATIONAL STOCK NUMBER TO "PALLET UNIT DATA" CHART.

REVISION NO. 15, DATED AUGUST 2005, CONSISTS OF:

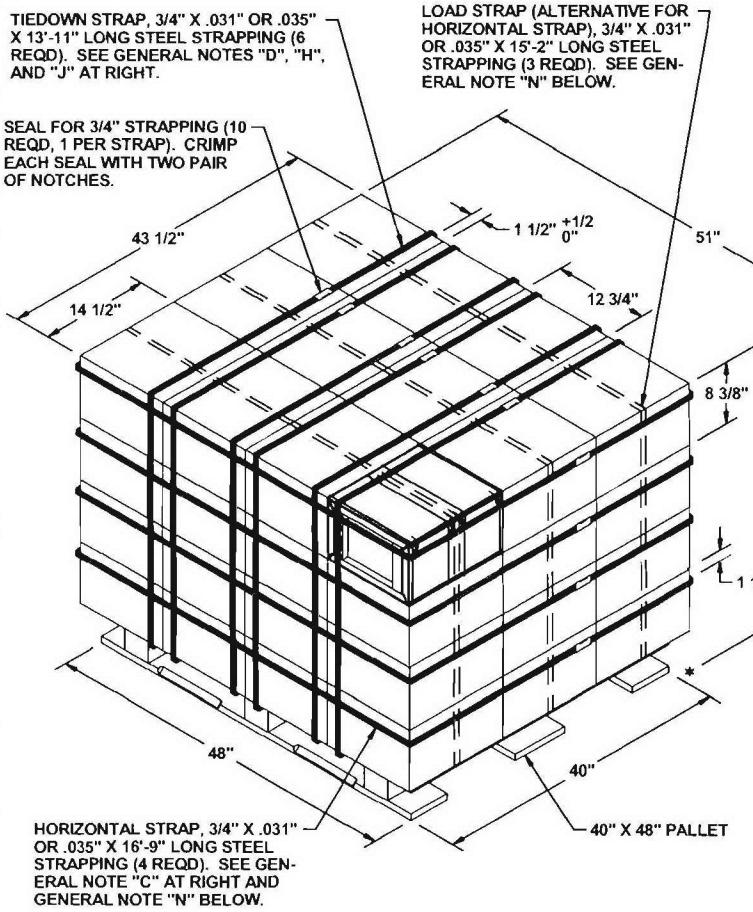
ADDING ITEMS BY NATIONAL STOCK NUMBER TO "PALLET UNIT DATA" CHART.

*HAZARD AND CLASSIFICATION DATA CONTAINED IN THE CHART AT RIGHT IS FOR GUIDANCE AND INFORMATIONAL PURPOSES ONLY. VERIFICATION OF THE SPECIFIED DATA SHOULD BE MADE BY CONSULTING THE MOST RECENT JOINT HAZARD CLASSIFICATION SYSTEM LISTING OR OTHER APPROVED LISTING(S).

#SEE GENERAL NOTE "L" ON PAGE 3.

[^]THESE ARE NAVY GENERATED NSNS, WHICH ARE MARKED AND PACKAGED IAW NAVY PACKING AND MARKING DRAWINGS, HOWEVER, THE NAVY DRAWINGS ARE SIMILAR TO ARDEC PACKING AND MARKING DRAWING 12576456.

PALLET UNIT DATA				
ITEMS INCLUDED		*HAZARD CLASS AND DIVISION	*COMPATIBILITY GROUP	APPROX WEIGHT (LBS)
NSN	DODIC			
1305-				
01-332-8254	A518	1.4	C	3,790
01-278-6880	A519	1.4	C	3,694
00-764-8386	A520	1.4	C	3,406
00-028-6309	A527	1.4	C	3,742
00-028-6307	A528	1.4	C	3,790
00-028-6562	A530	1.4	G	3,790
00-028-6449	A531	1.4	G	3,886
00-028-6474	A533	1.4	G	3,694
00-028-6592	A533	1.4	G	3,790
00-344-2394	A533	1.4	G	3,790
00-028-6451	A534	1.4	G	3,694
00-028-6471	A540	1.4	G	3,694
00-935-2017	A540	1.4	G	3,790
00-585-5194	A541	1.4	G	3,886
00-028-6601	A543	1.4	G	3,790
00-555-4057	A545	1.4	G	3,790
00-585-5191	A552	1.4	C	3,886
00-028-6574	A555	1.4	C	3,790
00-028-6583	A557	1.4	C	3,790
01-370-2594	A557	1.4	C	3,790
00-028-6381	A560		INERT	3,262
00-028-6383	A560		INERT	2,974
00-028-6384	A560		INERT	3,886
00-305-0894	A564	1.4	G	3,790
00-585-5189	A570	1.4	C	3,886
00-585-5188	A571	1.4	C	3,886
00-028-6609	A572	1.4	C	3,790
00-028-6610	A573	1.4	C	3,694
00-028-6611	A574	1.4	C	3,454
00-542-0408	A574	1.4	C	3,214
00-554-6745	A574	1.4	C	3,742
00-935-6067	A574	1.4	C	3,790
00-126-3852	A575	1.4	C	3,694
00-028-6603	A576	1.4	G	3,790
00-028-6604	A577	1.4	G	3,790
00-555-4056	A584	1.4	C	3,790
00-618-2400	A585	1.4	G	3,790
00-618-2399	A586	1.4	C	3,694
00-585-1667	A587	1.4	G	3,790
00-689-4709	A589	1.4	G	3,406
00-752-7891	A589	1.4	G	3,646
00-689-4738	A590	1.4	G	3,454
00-689-4752	A593	1.4	C	3,454
01-127-7870	A595	1.4	S	1,630
01-078-4879	A598	1.4	C	3,790
01-085-5118	A599	1.4	C	3,406
01-126-6201	A602	1.4	S	1,630
01-126-6200	A603	1.4	S	1,630
00-935-2109	A605	1.4	C	3,406
01-249-6888	A607	1.4	G	3,790
00-028-6582	A621	1.4	C	3,790
01-473-4774	AA06 [^]	1.4	G	3,790
01-462-0651	AA38	1.4	C	3,886
01-464-2541	AA41 [^]	1.4	G	3,934#
01-464-3218	AA42 [^]	1.4	G	3,934#
01-473-4766	AA50 [^]	1.4	G	3,790
01-481-3854	AA56	1.4	C	3,790
01-481-3852	AA57	1.4	C	3,790
01-482-1053	AA58 [^]	1.4	C	3,934#



PALLET UNIT
SEE GENERAL NOTE "B" AT RIGHT.

48 BOXES OF .50 CAL CARTRIDGE (240 PER BOX) @ 80 LBS -	3,840 LBS
DUNNAGE - - - - -	14 LBS
PALLET - - - - -	80 LBS

TOTAL WEIGHT - - - - -	3,934 LBS (APPROX)
CUBE - - - - -	50.1 CU FT (APPROX)

BILL OF MATERIAL

PALLET, 40" X 48" - - - - -	1 REQD - - - - -	80 LBS
STEEL STRAPPING, 3/4" - - - - -	150.50' REQD - - - - -	13.44 LBS
SEAL FOR 3/4" STRAPPING - - - - -	10 REQD - - - - -	NIL

(GENERAL NOTES CONTINUED)

N. LOAD STRAPS MAY BE USED IN LIEU OF HORIZONTAL STRAPS. LOAD STRAPS WILL BE LOCATED AS SHOWN IN THE DETAIL ABOVE. LOAD STRAPS MAY BE PRE-POSITIONED ON THE PALLET DECK OR THREADED THROUGH THE STRAP SLOTS. NOTICE: WHEN LOAD STRAPS ARE BEING USED IN LIEU OF HORIZONTAL STRAPS, THE THREE OUTBOARD BOXES ON THE BOTTOM LAYER OF THE 40" SIDES OF THE PALLET WILL BE POSITIONED WITH THE TOPS DOWNWARD, AND THE THREE OUTBOARD BOXES ON THE TOP LAYER OF THE 40" SIDES OF THE PALLET WILL BE POSITIONED WITH THE TOPS UPWARD.

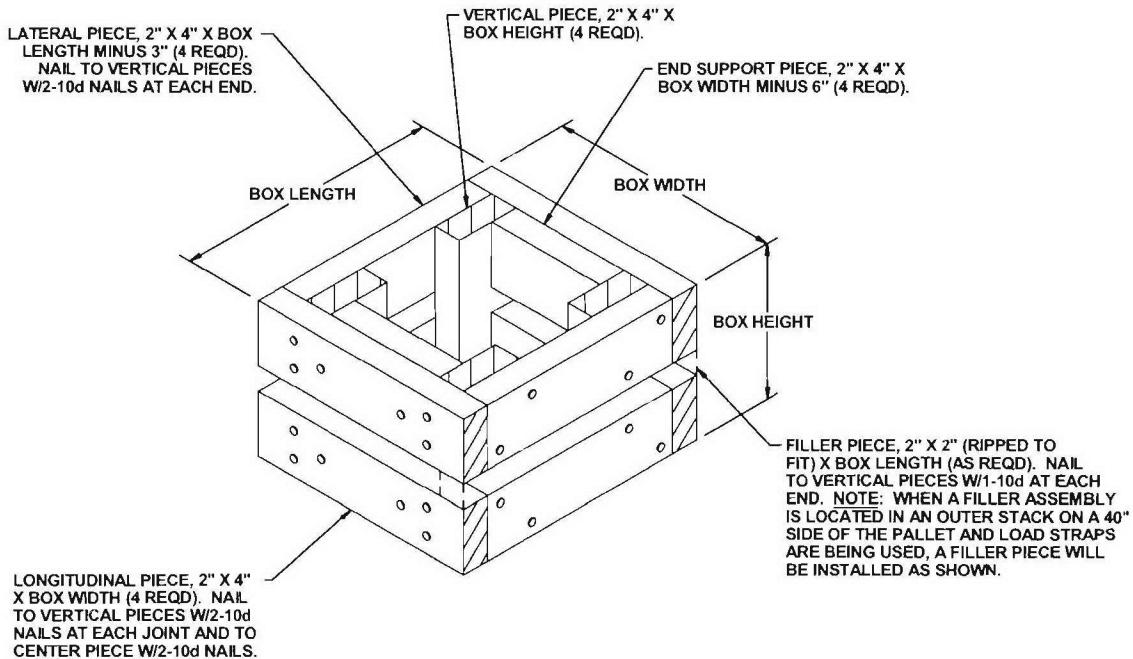
O. FOR DETAILS OF THE WIREBOUND BOX SEE ARDEC DRAWING 7553347.

GENERAL NOTES

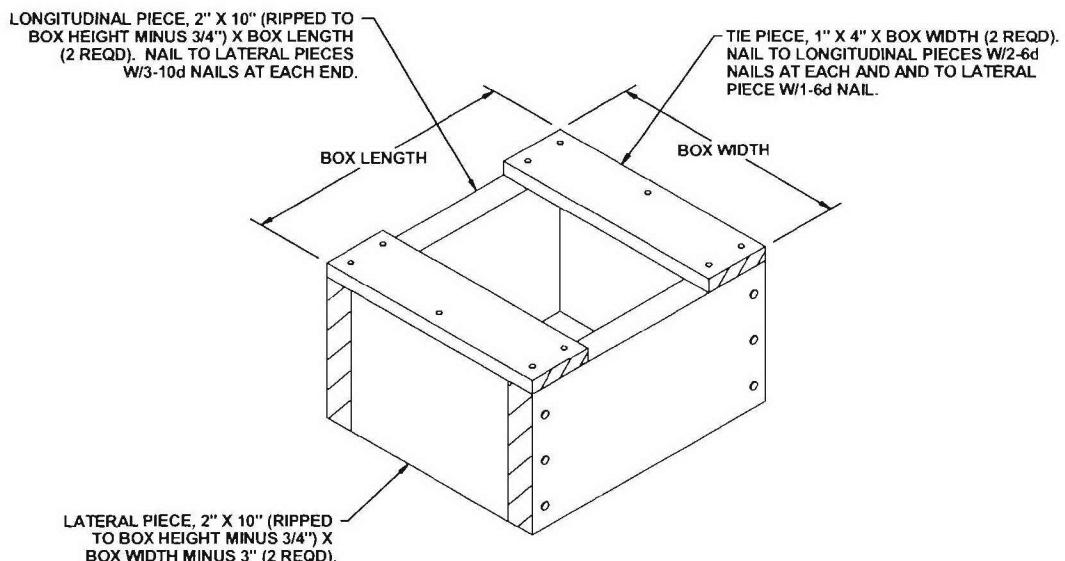
- A. THIS APPENDIX CANNOT STAND ALONE BUT MUST BE USED IN CONJUNCTION WITH THE BASIC UNITIZATION PROCEDURES DRAWING 19-48-4116-20PA1002. TO PRODUCE AN APPROVED UNIT LOAD, ALL PERTINENT PROCEDURES, SPECIFICATIONS AND CRITERIA SET FORTH WITHIN THE BASIC DRAWING WILL APPLY TO THE PROCEDURES DELINEATED IN THIS APPENDIX. ANY EXCEPTIONS TO THE BASIC PROCEDURES ARE SPECIFIED IN THIS APPENDIX.
- B. DIMENSIONS, CUBE AND WEIGHT OF A PALLET UNIT WILL VARY SLIGHTLY DEPENDING UPON THE ACTUAL DIMENSIONS OF THE BOXES AND THE WEIGHT OF THE SPECIFIC ITEM BEING UNITIZED.
- C. INSTALL EACH HORIZONTAL STRAP TO ENCIRCLE A LAYER OF BOXES ON THE PALLET. NOTE THAT THE STRAPS WILL BE LOCATED AS SHOWN, NEAR THE TOP OF EACH LAYER. HORIZONTAL STRAPS MUST BE TENSIONED AND SEALED PRIOR TO THE APPLICATION OF TIEDOWN STRAPS.
- D. INSTALL EACH TIEDOWN STRAP TO PASS UNDER THE TOP DECK BOARDS OF THE PALLET. NOTE THAT THE STRAPS WILL BE LOCATED AS SHOWN, NEAR THE SIDE CLEATS OF THE END PANELS OF THE BOX. TIEDOWN STRAPS WILL NOT BE APPLIED UNTIL THE HORIZONTAL STRAPS HAVE BEEN TENSIONED AND SEALED.
- E. THE FOLLOWING AMC DRAWINGS ARE APPLICABLE FOR OUTLOADING AND STORAGE OF THE ITEMS COVERED BY THIS APPENDIX.

CARLOADING - - - - -	19-48-4115-5PA1002
TRUCKLOADING - - - - -	19-48-4117-11PA1003
STORAGE - - - - -	19-48-4118-1-2-3-4-14-22PA1002
- F. IF ITEMS COVERED HEREIN ARE UNITIZED PRIOR TO ISSUANCE OF THIS REVISION TO THIS APPENDIX, THE BOXES NEED NOT BE REUNITIZED SOLELY TO CONFORM TO THIS REVISION.
- G. THE UNITIZATION PROCEDURES DEPICTED HEREIN MAY ALSO BE USED FOR UNITIZING .50 CALIBER CARTRIDGES WHEN IDENTIFIED BY DIFFERENT NATIONAL STOCK NUMBERS (NSN) THAN WHAT IS SHOWN ON PAGE 2, PROVIDED THE BOX PACK DOES NOT VARY FROM WHAT IS DELINEATED HEREIN. THE EXPLOSIVE CLASSIFICATION OF OTHER ITEMS MAY BE DIFFERENT THAN WHAT IS SHOWN.
- H. FOUR 1-1/4" STRAPS MAY BE SUBSTITUTED FOR THE SIX 3/4" TIEDOWN STRAPS SPECIFIED IN THE "PALLET UNIT" AT LEFT. POSITION THE FOUR 1-1/4" STRAPS WHERE THE OUTWARD 3/4" STRAPS ARE POSITIONED. REFER TO GENERAL NOTE "CC" IN THE BASIC UNITIZATION DRAWING 19-48-4116-20PA1002 FOR ADDITIONAL GUIDANCE.
- J. WHEN THE TOTAL WEIGHT OF A 48-BOX UNIT IS 2,800 POUNDS OR LESS, ONLY FOUR TIEDOWN STRAPS WILL BE REQUIRED TO RETAIN THE BOXES ON THE PALLET. OMIT THE CENTER TWO TIEDOWN STRAPS.
- K. IF DEEMED MORE ECONOMICALLY FEASIBLE, THE ALTERNATIVE FILLER ASSEMBLY MAY BE SUBSTITUTED FOR THE FILLER ASSEMBLY TO COMPLETE A LAYER ON A PALLET.
- L. IF THE TOTAL WEIGHT OF A 48-BOX UNIT LOAD EXCEEDS 4,000 POUNDS, A SUFFICIENT NUMBER OF BOXES MUST BE REPLACED WITH "FILLER ASSEMBLIES", AS DEPICTED ON PAGE 4, SO THAT THE TOTAL UNIT WEIGHT IS EQUAL TO OR SLIGHTLY LESS THAN THE 4,000 POUND MAXIMUM ALLOWABLE UNIT WEIGHT.
- M. THE STYLE 1 PALLET DELINEATED IN THE DETAIL AT LEFT NEED NOT HAVE CHAMFERS OR STRAP SLOTS AS SPECIFIED WITHIN MILITARY SPECIFICATION MIL-P-15011 WHEN USED FOR THE UNITIZATION OF ITEMS COVERED BY THIS APPENDIX.

(CONTINUED AT LEFT)



FILLER ASSEMBLY
(FOR MINUS ONE BOX)



ALTERNATIVE FILLER ASSEMBLY
(FOR MINUS ONE BOX)
SEE GENERAL NOTE "K" ON PAGE 3.

PART 7- REFERENCE PULL TEST DATA

In conjunction with the MIL-STD-1660 unit load tests, the ARDEC Packaging Office in Rock Island, IL conducted pull tests on $\frac{3}{4}$ " wide steel samples of strapping provided by LCAA, manufactured by Samuel Strapping, and sealed on the automatic palletizer equipment with Frey and Weishe, Strapping Head WS 19/3 + 1. Pull tests were conducted on three clipped samples and three bare samples of strapping followed by six clipped samples that were salt spray tested IAW ASTM-B117 for 336 hours. All 12 strapping samples met the minimum breaking strength requirements of ASTM-D3953. The crosshead separation speed of the test equipment was 1"/minute during the pulls. The results of that test are as follows:

CLIPPLESS SAMPLES: (lbs @ failure) - ASTM-D3953 requires 75% joint strength efficiency that equates to 2,138 lbs for this strapping. These were conducted on May 15, 2006.

2,320 lbf
2,440 lbf
2,260 lbf
2,340 lbf average

UNCLIPPED (Parent/bare) SAMPLES: (lbs @ failure) - ASTM-D3953 requires 2,850 lbf strength for bare strapping. These were conducted on May 15, 2006.

2,994 lbf
3,035 lbf
3,016 lbf
3,015 lbf average

The elongation of the last sample was taken for informational purposes only. ASTM-D3953 requires elongation between 6.5 to 12%. The third sample had a tested elongation of 8.3%.

CLIPPLESS SAMPLES AFTER 336 HOUR SALT SPRAY: (lbs @ failure) - ASTM-D3953 requires 2,138 lbs for this type of joined strapping. These were conducted on May 26, 2006.

2,516 lbf
2,392 lbf
2,480 lbf
2,546 lbf
2,542 lbf
2,495 lbf
2,495 lbf average

Additional pull tests were conducted on eight samples of 3/4"-wide steel of clipped seals made from the automatic palletizer using the head that made the notches in the horizontal banding that had the tear drop notch not punctured all the way through the strapping. These samples were pull tested on June 12, 2006.

2,386 lbf
2,471 lbf
2,472 lbf
2,440 lbf
2,556 lbf
2,569 lbf
2,475 lbf
2,541 lbf